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GAMBEL OAK CONTROL ON THE BEAVER CREEK PILOT WATERSHED IN ARIZONA

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Gambel Oak Control on the Beaver Creek Pilot Watershed in Arizona

By

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INTRODUCTION

Gambel oak (Quercus gambelii Nutt.) is widely distributed in Arizona, Colorado, Nevada, New Mexico, and Utah in ponderosa pine (Pinus ponderosa Laws.) forests and the higher areas of pinyon-juniper woodlands. This oak grows as a shrub on unfavorable sites with shallow soils and as a tree on favorable sites with deep soils (1).[2] Its extensive lateral root system produces sprouts; therefore, clumps of trees may be single, interconnected plant complexes. This oak also sprouts readily from the trunk and tree base. Sprouts may form dense thickets after fires. Gambel oak is considered poisonous for livestock, especially during the early spring (6), but is also considered a source of browse and mast for deer and wild turkey (7, 2).

Control of Gambel oak may be desirable for ponderosa pine planting site preparation (8) and for range (5) or watershed improvement (9). Control is difficult, however, because of the profuse sprout production after top growth is damaged.

Few reports have been published concerning Gambel oak control. Heikes (3) reported that in Colorado 4-amino-3,5,6-trichloropicolinic acid (picloram) applied at 1 1/2 pounds per acre with a mist blower controlled Gambel oak, with little regrowth. Jefferies (4) reported 82-percent defoliation in Colorado with 2 pounds acid equivalent per acre (ae/A) of esters of 2,4,5-trichlorophenoxyacetic acid (2,4,5-T) or 2-(2,4,5-trichlorophenoxy)propionic acid (silvex) in a volume of 100 gallons per acre, each followed by successive treatments with 1 pound per acre of the same herbicide each year for 2 more years. Pearl (8) reported 65-percent defoliation and 28-percent stems killed 16 months after treatments with either inverted water-in-oil emulsions of esters of 2,4,5-T, or silvex, or an oil soluble amine of 2,4,5-T, all applied aerially at a rate of 2 pounds per acre in a volume of 8 gallons per acre in New Mexico.

Our report summarizes the results of various attempts to control Gambel oak on the Beaver Creek Pilot Watershed in Arizona from 1957 through 1964 (10).

METHODS AND MATERIALS

In many of our early control tests, we used methods that were successful elsewhere on other species of oak. Most of the tests done during 1962 and after were preliminary herbicide evaluation trials.

Control of Tree Crowns

A number of control methods were tested on sample plots during 1957. Included were: (a) felling the tree [107 trees, 1 to 12 inches diameter breast high (DBH)]; (b) placing ammonium sulfamate (AMS) crystals on freshly sawn stumps [60 trees, 1 to 18 inches DBH]; (c) power girdling of standing trees [96 trees, 2 to 22 inches DBH]; (d) power girdling of tree trunks and painting the girdles with a saturated solution of AMS [50 trees, 2 to 14 inches DBH]; and (e) ax frilling of tree trunks near the base and placing 1 tablespoonful of AMS crystals or a saturated solution of AMS into each frill cup [66 trees, 1 to 19 inches DBH].

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[2] Underscored numbers in parentheses refer to Literature Cited, page 8.

Injecting 2,4,5-T concentrate or a saturated solution of AMS into Gambel oak trunks with a mechanical tree injector was tested on sample plots during 1958. The sizes and number of trees used in this trial are not known.

During the summer of 1959, either a saturated solution of AMS containing a dye or 1 tablespoon of AMS crystals was placed in frill cups cut into the sapwood and spaced about 4 inches apart near the tree base. This was part of a thinning treatment on an area of 2,000 acres. An average of 119 trees per acre were on this area; all stems 2 or more inches in diameter were treated.

Control of Sprouts

All treatments to control sprout growth were applied to individual clumps and not as area broadcast applications. Most foliage spray treatments were "wetting sprays" in which the top growth was sprayed until the spray ran off the foliage.

Gambel oak sprouts on 122 acres were treated with foliage sprays containing 16 pounds acid equivalent of an amine salt of 2,4,5-T per hundred gallons (aehg) of solution during August 1960. During October 1961, 70 acres of this area were re-treated by spraying the foliage with a solution containing 32 pounds aehg of an amine salt of 2,4,5-T. Spraying stem bases, spraying upper leaves and branches, and spraying to completely cover the clumps were compared on nine plots; there were three plots for each treatment method used.

Seven and one-half acres of an oak stand with 150 sprout clumps per acre were treated with 16 pounds aehg of an ester of 2,4,5-T during June and July 1962. Three types of treatments were applied: (a) complete spray coverage of top growth with 2,4,5-T in an oil carrier; (b) about four-fifths of the top growth of the clump sprayed and the stem bases saturated with 2,4,5-T in an oil carrier; (c) four-fifths of the top growth sprayed and the stem bases saturated with 2,4,5-T in a water carrier. An adjacent untreated area was used as a check plot.

During 1958, and again during 1959, an ester of 2,4,5-T was applied to foliage and stems of sprouts as part of a timber conversion project on a 175-acre watershed. Sprout growth was affected very little by these treatments; therefore, dormant-basal spray of 12 pounds aehg of an ester of 2,4,5-T in diesel oil was applied on the same area during March 1962. The dormant-basal treatments were sprayed in a band around the stem bases, allowing the solution to flow down the bark into the ground. Although all clumps in the area were treated, only 82, selected at random throughout the area, were used to evaluate the results. Several untreated areas were used as checks.

A number of herbicides have been tested for controlling Gambel oak sprouts. Ten herbicidal formulations were tested on clumps of sprouts, with 10 clumps per treatment, during May 1962. Included were: 3-phenyl-1,1-dimethylurea (fenuron); 3-phenyl-1,1-dimethylurea trichloroacetate (fenuron-TCA); trichloroacetic acid (TCA); polychlorobenzoic acid (PBA); 2,3,6-trichlorobenzoic acid (2,3,6-TBA) 3-amino-1,2,4-triazole (amitrole); 2,4-dichlorophenoxyacetic acid (2,4-D); mixtures of 2,4-D and 2,4,5-T; silvex; and inverted water-in-oil emulsions of 2,4,5-T. Picloram was applied as a foliage spray at a concentration of 4 pounds of picloram aehg in water during August 1963. During 1964 a mixture of 4 pounds of picloram plus 8 pounds of 2,4-D aehg in water was applied as a foliage spray with a mist blower.

Observations

Damage from all treatments was evaluated by visual estimates of percentage defoliation and stems killed. Sprout frequency and browse production from an AMS-treated area were measured on randomly located 9.6-square-foot plots; there were 92 plots on the treated area and 338 on the untreated area. Browse production was determined by weight estimates of browse in a circular plot projected 7 feet high.

RESULTS AND DISCUSSION

Tree crowns of Gambel oak on Beaver Creek have much natural die-back (table 1). Thus, small amounts of tree crown damage may be due to factors other than the treatment applied. Sprouts, however, had very little natural die-back, a factor that indicates that damage following herbicide treatment was probably due to the treatment applied.

Table 1.--The percentage of dead crown on Gambel oak trees in untreated areas compared with the percentage in areas where the trees were treated with AMS in ax frills

Area	Trees in dead crown classes of--		
	0-10 percent	20-80 percent	90-100 percent
	Percent	Percent	Percent
Treated......	1	20	79
Untreated....	18	51	31

Control of Tree Crowns

Gambel oak tree crown reduction was obtained by (a) felling the tree or (b) treating trunk frills or girdles with AMS (table 2). Profuse sprouting from the base and roots commonly follows these treatments. The number and size of sprouts were both greater on the AMS-treated area than on similar adjacent untreated areas (fig. 1). No relationship between sprout frequency treated-tree size was shown. Treating freshly sawed stumps with AMS did not reduce basal or root sprouting.

Browse production of Gambel oak sprouts averaged 88 pounds per acre on an AMS-treated area, about six times that on adjacent untreated areas (fig. 1). This increased browse production caused by killing the oak tree crowns would be beneficial for deer management in areas with limited available browse. However, mast production would be reduced if the vegetation were changed from oak trees to oak sprouts (7).

Control of Sprouts

Excessive sprouting was effectively reduced with the dormant-basal spray treatments of 2,4,5-T (table 2). To obtain the best results, it was apparent that the stem-root transition zone must be thoroughly wetted by the spray solution. Re-treatment has not been necessary during 5 years' observations. Stem sprays of 2,4,5-T during the growing season caused little damage.

Most of the other herbicide treatments showed little lasting effect on Gambel oak sprouts (table 2). The stems may be killed but the roots are seldom killed, and damaged plants quickly grow again.

The results obtained with dormant-basal spray treatments agree with results obtained from similar treatments of Gambel oak in western Colorado during 1951. Because this method of treatment is laborious, it probably would not be used to treat areas over several hundred acres in size or sprouts growing in extensive thickets. The method seems to be suited for use on small areas and on clumps in very scattered stands.

Applications of pelleted fenuron to the soil kill Gambel oak sprouts (table 2). However, this method of treatment is limited by high costs, ineffectiveness on clay soils, and damage to grass by broadcast applications at the rates needed for satisfactory oak control. The soil may be bare for several years after fenuron broadcast applications. There may also be herbicide residues in the soil that would adversely affect conifer species planted shortly after broadcast applications. Although fenuron has a low mammalian toxicity, present restrictions prohibit livestock grazing for 90 days after treatment.

Complete coverage with foliage sprays defoliates the Gambel oak more effectively than incomplete coverage, a response also reported for numerous other species. However, few plants were killed by foliage sprays. Foliage spray treatments, repeated for 2 years with an ester of 2,4,5-T, did not kill Gambel oak on Beaver Creek. So far, foliage applications of picloram have not been as successful in

Table 2.-- Response of Gambel oak to various treatments applied from 1957 through 1964, Beaver Creek Watershed

Treatment[1]	Herbicide rate[2]	Time of application		Results[3]
		Year	Season	
CONTROL OF TREE CROWNS				
Stump applications:				
Fell tree	0	1957	Winter	All stumps sprouted.
Fell tree and AMS crystals on stump	Cover stump	1957	...do...	67% sprouts killed but plants regrew.
Cut-surface applications:				
Girdle trunk	0	1957	...do...	50% tops killed, 93% plants sprouted.
Girdle trunk and saturated solution of AMS	Painted girdle	1957	...do...	100% tops killed, 84% plants sprouted.
Frill trunk and saturated solution or crystals of AMS	1 tbsp. per cut	1957	...do...	88% tops killed, 69% plants sprouted.
Frill trunk and saturated solution of AMS	1 tbsp. per cut	1959	Summer	78% tops killed, 74% plants sprouted.
Trunk injections:				
2,4,5-T concentrate	(4)	1958	Fall	Little effect.
AMS saturated solution	(4)	1958	...do...	Do.
CONTROL OF SPROUTS				
Stem-foliage applications:				
Amine salt of 2,4,5-T	12 lb. aehg	1958	Spring	Little effect.
Do	12 lb. aehg	1959	...do...	Do.
Do	16 lb. aehg	1960	Summer	Do.
Do	32 lb. aehg	1961	Fall	Little effect, complete coverage best.
Esters of 2,4,5-T	16 lb. aehg	1962	Spring	10% tops killed, plants sprouted.
Do	16 lb. aehg	1962	Summer	30% tops killed, plants sprouted.
Esters of 2,4,5-T	12 lb. aehg	1958	(4)	10% tops killed, plants sprouted.
Do	12 lb. aehg	1959	(4)	Do.
Esters of 2,4-D	12 lb. aehg	1962	Spring	10% tops killed, plants sprouted.
Esters of 2,4-D and 2,4,5-T	12 lb. aehg	1962	...do...	Do.
Ester of silvex	12 lb. aehg	1962	...do...	Do.
Amitrole	12 lb. aehg	1962	...do...	Little effect.
Inverted emulsion of 2,4,5-T	12 lb. aehg	1962	...do...	Do.
PBA	12 lb. aehg	1962	...do...	No damage.
2,3,6-TBA	12 lb. aehg	1962	...do...	Do.
Picloram	4 lb. aehg	1963	Summer	Do.
Picloram and 2,4-D	4 and 8 lb. aehg	1964	...do...	10% tops killed, plants sprouted.
Soil applications:				
Fenuron	8 lb. ae/A	1962	Spring	80% plants killed, some sprouting.
Fenuron-TCA	8 lb. ae/A	1962	...do...	40% plants killed, some sprouting.
Fenac	8 lb. ae/A	1962	...do...	No damage.
PBA	8 lb. ae/A	1962	...do...	Little effect.
TBA	8 lb. ae/A	1962	...do...	Do.
TCA	8 lb. ae/A	1962	...do...	No damage.
Dormant-basal spray:				
Ester of 2,4,5-T	12 lb. aehg in diesel oil.	1962	...do...	73% plants killed, sprouts repressed.

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[1] Rates and carriers listed in text.
[2] aehg = acid equivalent per 100 gallons; ae/A = acid equivalent per acre.
[3] Little effect indicates less than 10 percent of the top damaged.
[4] Data not available.

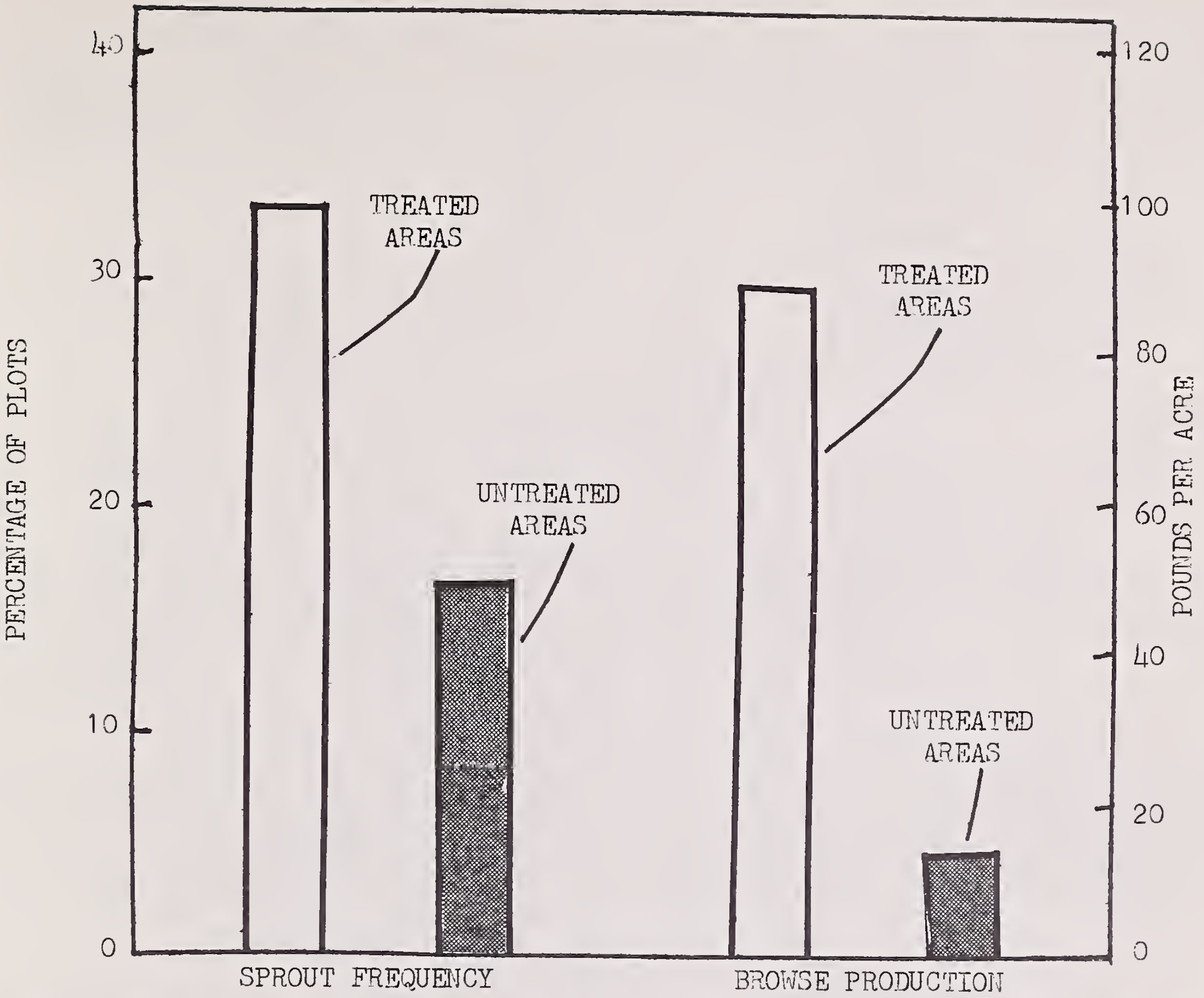

Figure 1.--Gambel oak sprout frequency and browse production from areas with AMS frill-treated trees and adjacent similar untreated areas.

Arizona as they have been in Colorado (3). However, the results of the picloram treatments on Beaver Creek agree with the results at several other Arizona locations.

SUMMARY

Tree crowns of Gambel oak on the Beaver Creek Pilot Watershed, Arizona, were killed by felling the tree and by treating trunk frills or girdles on standing trees with a saturated solution of AMS or AMS crystals. Profuse sprouting from the base of the tree and the roots followed these treatments. Stump treatments with AMS did not reduce basal or root sprouting.

Dormant-basal applications of 12 pounds aehg of an ester of 2,4,5-T in diesel oil killed many plants and repressed sprouts. Pelleted fenuron treatments also reduced Gambel oak sprouts. Other herbicides tested had little effect on Gambel oak.

LITERATURE CITED

(1) Brown, H. E.
1958. Gambel oak in west-central Colorado. Ecology 39: 317-327.

(2) Dietz, D. R.
1965. Deer nutrition research in range management. 13th North Amer. Wildlife & Nat. Resource Conf. Trans., Wildlife Mangt. Inst., West Bldg., Washington, D.C. pp. 274-285.

(3) Heikes, E. G.
1964. Tordon and other herbicides field testing for the control of deep-rooted perennial weeds in Colorado. Down to Earth 2(3): 9-12.

(4) Jefferies, N. W.
1965. Herbicide studies on Gambel's oak in southwestern Colorado. West. Weed Control Conf. Res. Prog. Rpt., pp. 39-40.

(5) ______________
1965. Herbage production on a Gambel oak range in southwestern Colorado. Jour. Range Mangt. 18 (4): 212-213.

(6) Kingsbury, J. M.
1964. Poisonous plants of the United States and Canada. 626 pp. Prentice-Hall, Inc., Englewood Cliffs, N.J.

(7) McCulloch, C. Y., Wallmo, D. C., and Ffolliott, P. F.
1965. Acorn yield of Gambel oak in northern Arizona. U.S. Forest Serv. Res. Note RM-48, 2 pp.

(8) Pearl, R. W.
1965. Gambel oak control in New Mexico. West. Weed Control Conf. Res. Prog. Rpt., p. 40.

(9) Tew, R. K.
1966. Soil moisture depletion by Gambel oak in northern Utah. U.S. Forest Serv. Res. Note INT-54, 7 pp.

(10) Worley, D. P.
1965. The Beaver Creek pilot watershed for evaluating multiple-use effects of watershed treatments. U.S. Forest Serv. Res. Paper RM-13, 12 pp.